

Evaluation of Geopolymer Concrete for Rocket Test Facility Flame Deflectors

The current paper presents results from a combined research effort by Louisiana Tech University (LTU) and NASA Stennis Space Center (SSC) to develop a new alumina-silicate based cementitious binder capable of acting as a high performance refractory material with low heat ablation rate and high early mechanical strength. Such a binder would represent a significant contribution to NASA's efforts to develop a new generation of refractory 'hot face' liners for liquid or solid rocket plume environments. This project was developed as a continuation of on-going collaborations between LTU and SSC, where test sections of a formulation of high temperature geopolymer binder were cast in the floor and walls of Test Stand E-1 Cell 3, an active rocket engine test stand flame trench. Additionally, geopolymer concrete panels were tested using the NASA-SSC Diagnostic Test Facility (DTF) thruster, where supersonic plume environments were generated on a 1ft wide x 2ft long x 6 inch deep refractory panel. The DTF operates on LOX/GH2 propellants producing a nominal thrust of 1,200 lbf and the combustion chamber conditions are $P_c=625\text{psig}$, $O/F=6.0$. Data collected included high speed video of plume/panel area and surface profiles (depth) of the test panels measured on a 1-inch by 1-inch giving localized erosion rates during the test. Louisiana Tech conducted a microstructure analysis of the geopolymer binder after the testing program to identify phase changes in the material.